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GYPSUM

The 1953 production of gypsum in California was 1,199,489 short tons valued at \$2,855,983, which is about 10 percent of the United States production of gypsum. The principal commercial uses of gypsum depend on three facts: when it is calcined at a moderate temperature, a material forms that sets or hardens when it is mixed with water; 2) it improves the texture of certain types of soil; and 3) it retards the naturally fast setting time of portland cement. In California, rock gypsum is quarried in the Little Maria Mountains, Riverside County; the Fish Creek Mountains, Imperial County; and near Cuyama Wash, Ventura County. Gypsite is mined from the southwestern part of the San Joaquin Valley; Carrizo Plain, San Luis Obispo County; and eastern Kern County. An additional tonnage of synthetic gypsum not included in the production figures above, is obtained as a by-product of the magnesia manufactured from salt works bittern at Newark, Alameda County. Although there are undeveloped gypsum deposits in California, 200,000 to 300,000 tons a year of raw gypsum and finished gypsum products, aided by favorable transportation costs, are brought into the state. Raw gypsum comes by ship from San Marcos Island in the Gulf of California; raw gypsum and gypsum products come by rail from Nevada.

Mineralogy and geology. Gypsum is the natural calcium sulfate hydrate $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$. Most commercial gypsum is a massive material that contains a minimum of 90 percent of the mineral gypsum and is known as rock gypsum. Gypsite, formerly called gypsum earth, consists of gypsum mixed with sand or clay in earthy, fine grained deposits; it also is important commercially. Most commercial gypsite contains from 50 to 70 percent gypsum. Other less common varieties of gypsum are the platy, transparent type known as selenite, the fibrous type known as satin spar, and the massive white, sometimes translucent type called alabaster. Gypsum is commonly associated with anhydrite (CaSO_4), a mineral of little present commercial value.

Most calcium sulfate minerals have formed through the evaporation of sea or saline lake waters, but some also occur in hydrothermal veins, in near-surface veins formed by deposition from ground water, and as replacements of limestone. In saline deposits at least part of the calcium sulfate is believed to have originally precipitated as anhydrite and to have been altered to gypsum by the

action of ground water. Gypsite forms in regions of little rain and high evaporation. Calcium sulfate-bearing ground water is drawn upward by capillary action, and small gypsum crystals form at or close to the surface.

LOCALITIES

In California the rock gypsum deposits that have been worked are in mildly metamorphosed pre-Tertiary rocks and in Tertiary non-marine sedimentary rocks. From 1906 to 1924 a playa deposit of Quaternary age was the largest single source of gypsum in the state, but it is no longer worked. Most of the gypsite mined in California is obtained from Recent surficial deposits.

Pre-Tertiary deposits. Pre-Tertiary deposits of gypsum occur in the Little Maria Mountains, Riverside County, where the Midland operations of the United States Gypsum Company and the Garbutt and Orcutt deposit are located. The gypsum beds form part of a series of slightly metamorphosed sedimentary rocks that trends across the range from east to west. The sediments are in fault contact with intrusive granitic rocks on the north and are bordered on the south by gneiss. The rocks of the gypsum belt are quartzite, crystalline limestone, and quartz-albite-mica schist that dip 50° - 80° NW. Gypsum occurs in the limestone as persistent beds as much as 50 feet thick and in the schist as lenticular bodies that have a more limited extent. The gypsum is a coarse-grained aggregate of transparent grains. Although thick beds of nearly pure gypsum do occur, much of the gypsum contains thin layers of schist, tremolitic limestone or quartz. Anhydrite is present at depth and is the mineral from which the gypsum has formed. Similar but undeveloped deposits have been found in the Maria Mountains, the Palen Mountains (Hoppin, 1954), and the Riverside Mountains, Riverside County.

A pre-Tertiary deposit in unmetamorphosed rock occurs on the south slope of Clark Mountain, in San Bernardino County, 12 to 13 miles from U.S. highway 91 and the Union Pacific Railroad near the California boundary. In this area two or more gypsiferous zones can be traced for 1 to 2 miles. The gypsum is associated with black, thin-bedded, cherty limestone, sandy limestone, and brown shale that are members of the Permian Kaibab formation.